WIND TUNNELS FOR BALLISTICS

Remarks at the Dedication of the Naval Supersonic Laboratory
Massachusetts Institute of Technology
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National Advisory Committee for Aeronautics
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I am very happy to bring to you the greeting and best wishes of the staff of the National Advisory Committee for Aeronautics on the occasion of the dedication of the Naval Supersonic Laboratory. In the early days of our republic every citizen was expected to respond when needed to the call for military service. In the nearly two hundred years of our national existence the responsibility of citizenship has become much more complex but no less important to national welfare. The establishment of this laboratory is a modern form of response of civilian scientists and of a great civilian institution to the call for national service. As a national policy we seek technological strength to be used as a tool for the maintenance of peace and security. An essential element of this policy is a close collaboration between military men and civilian scientists, each having an inescapable responsibility to contribute to the common welfare.

We have done more than dedicate a wind tunnel, a piece of inanimate equipment, in itself capable of creating nothing. We have, I hope, dedicated the talents of the scientific leaders of this institution to contribute to the advancement of knowledge in the field of fluid mechanics and thermodynamics. For the wind tunnel itself is only a means to an end, a tool to be used by

intelligent and purposeful men for advancing knowledge and creating still other tools, to be used, if needed, to defend our way of life. Because of the human environment of this laboratory, and not because of the machinery it contains, we look forward to its future productivity with confidence.

One of the specific results to be expected is the cross-fertilization of ideas between the hitherto separate fields of ballistics and aerodynamics. Ballistics began with the art of throwing stones, progressed, if it can be called progress, to the propulsion of round balls of iron and steel by means of exploding powder in guns and cannon, and in more recent times came to include the motion of rifled projectiles at supersonic speeds and the motion of falling bombs at subsonic speeds. Because the effects of aerodynamic forces are of the nature of perturbations of the classical Newtonian trajectories, exact knowledge of them awaited the slow development of refined techniques for the accurate measuring of distance and times on the open range. Aerodynamics as an experimental science developed much more rapidly than ballistics through the advent of wind tunnels. The aeronautical subsonic wind tunnel and the concepts developed through its use exercised a great influence on ballistics. Today, ballistics and aerodynamics are essentially a single science as the projectile and the airplane merge to become the guided missile and each has borrowed the special techniques of the other to mutual benefit.

The position of the wind tunnel in aeronautics can be appreciated from the fact that there are in operation in the United States at the present time

eighty-eight wind tunnels with cross section of three square feet or more and with speeds less than the speed of sound. They are used for instruction, research, development, and evaluation. They are located at universities, industrial plants, and governmental laboratories. By their aid this country has produced aircraft of superior performance. In contrast, ballistics until very recently had but a single supersonic wind tunnel.

There are at present only nine supersonic wind tunnels in this country three square feet or larger. Because of their cost, there will be a fewer number of supersonic than subsonic wind tunnels and there must be more intensive utilization. However, the greatly increased number and types of problems, and the large speed range to be covered, will require more than the present nine supersonic wind tunnels, perhaps not as many as eighty-eight.

At the end of the last war we discovered that Germany had made considerable progress in rockets, jet propulsion, and supersonic aerodynamics. It was obvious that vigorous and concerted action was necessary to advance our proficiency in these fields. As a result of the action taken, this country led the advance of aircraft speeds through the speed of sound by means of a cooperative research airplane program in which the first human flight at supersonic speed was achieved. The significance for the national defense is obvious. However, it was early realized that the development of practical supersonic military aircraft depends on the availability of supersonic wind tunnels as development tools. The penalties for design mistakes in

supersonic airplanes are much more costly in time, money, and human life than in subsonic airplanes, and the consequences of mistakes are more readily apparent to the public than, for example, in most ballistic developments.

A survey of all of the national needs in high-speed aerodynamics was made by the Air Force, Navy, and NACA and a unitary plan to meet these needs was initiated in 1946. This plan has been reviewed and, in its final form, approved by many agencies including the Army, Navy, Air Force, Research and Development Board, Secretary of Defense, National Advisory Committee for Aeronautics, the aircraft industry, the President's Air Policy Commission, the Congressional Aviation Policy Board, the Bureau of the Budget, and the Congress. In these reviews, extending over three years, consideration was given to the urgent needs resulting from attainment of supersonic speeds by aircraft and large missiles, to the capabilities of existing and planned wind tunnels, to the elimination of duplication, and to maximum utility. The authorizing legislation passed the last session of Congress, as well as an appropriation to begin that portion assigned to the Air Force. NACA will request an initial appropriation for its part early in the next session of Congress.

The Unitary Plan first recognized the need for competent and adequately trained personnel and in particular that adequate training could not be given without access of the students to experimental apparatus. Hence provision has been made for placing small supersonic facilities at educational

institutions to acquaint students with the technical problems of high-speed aerodynamic research and development and to provide facilities for thesis research. The probable contributions of universities to fundamental research were widely recognized. The intent is to assist universities with the capital expenditures for equipment, the equipment to be of sufficiently small scale that the operating expense would be very small and within the normal budget of the university.

In the original discussion the need was recognized for a few larger installations, and these were undertaken under sponsorship of the military services. The wind tunnel dedicated here today is an outcome of these early discussions and may truly be considered a part of the unitary plan, though fortunately its authorization and construction were not deferred as long as that of the other wind tunnels of the plan.

No large wind tunnels specifically for research purposes are included in the Unitary Plan as finally approved. Fortunately under the leadership of Dr. Hunsaker and the late Dr. Lewis the NACA initiated in 1945 the construction of three large supersonic wind tunnels with speeds up to twice the speed of sound which are now in operation.

The large wind tunnels in the Plan provide a combination of speed and size urgently needed for the successful development of supersonic aircraft and guided missiles and unobtainable in existing equipment. They are to perform in the supersonic field the same function as performed by the numerous subsonic wind tunnels located at industrial plants and universities in the

subsonic field. Economy is to be obtained by a policy spelled out in the legislation through which time is to be allocated to manufacturers holding development contracts. The Air Force, Navy, and NACA are entrusted with the operation of specific wind tunnels under this common policy. The Plan contemplates three two-foot, two four-foot, three eight-foot, and one hypersonic wind tunnel at an estimated cost of approximately two hundred million dollars. Needless to say the implementation of a program must be extended over a number of years in the present state of the national budget, but if we are to maintain leadership in supersonic aircraft and guided missiles, the facilities must be completed as soon as financially possible. If the cost seems unduly large may I help you keep the proper perspective by reminding you that it corresponds to two per cent of the cost of the airplanes purchased in a single year of the last war. If we are again forced into war, this sum is a small premium to pay to insure superior performance of our aircraft.

May I return for a moment to the more modest installation of the Naval Supersonic Laboratory, which is a laboratory ready to work, and not a mere plan, and make an observation directed especially to our military partners. At lunch yesterday in New York I sat next to a Philadelphia industrialist who discussed the importance of research in his business. He stated that for some years accounts were kept in which the research department was credited with modest royalties on its output of ideas adopted.

After a few years the evidence of the great monetary return of research was so conclusive that the accounting was dropped. The company now puts an amount equal to about three per cent of its sales in research. The task of the management is now not to sell the directors the value of research but to convince them that research has limitations and cannot perform miracles on request. I am convinced that a modest investment in this well qualified laboratory staff, for whom such an excellent tool has been provided, if continued over a reasonable period, will bring dividends to ballistics in terms of new knowledge which will aid in the design of better weapons. There is no lack of problems to be solved; let there be no lack of faith in the value of the results which accrue from support of a good research team, results of greater potentiality than those of any current specific development project.